Men and Books

A HISTORY OF EMBRYOLOGY*

(A REVIEW)

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This outstanding contribution to the history of science first appeared, in less extended form, as a part of the historical introduction to Dr. Needham's monumental work on "Chemical Embryology" published in 1931, and its content was embodied also in a series of lectures delivered by him about that time at the University of London, entitled "Speculation, Observation and Experiment, as illustrated by the History of Embryology". The book, amplified to its present form from the above source, is the first really exhaustive treatise ever published in its field. As such it is of fundamental importance, for it presents a critical evaluation of the successive contributions made to our understanding of this, the most intriguing of all mysteries, from the first glimmerings of speculation into the nature of generation made in antiquity, to the observations of the great biologists of the 16th, 17th and 18th centuries. The account closes in the year 1800 A.D.; for the new methods of quantitative physico-chemical experimentation and anatomical reconstruction developed in the nineteenth century opened up fresh paths of enquiry and unlocked many complex problems for solution that have resulted in a vast material necessitating a second publication, which is now, we are told, under preparation.

In the volume before us contemporary events and individuals of significance are reviewed in broad historical perspective with the help of two graphic chronological charts, original with the author, covering the periods from 600 B.C. to 600 A.D., and from 1450 to 1800 A.D. The hiatus between the two corresponding to the cessation of creative work in this subject that took place in the pre-Renaissance period under the influence of the so-called "Patristic writers". This treatment, and the wide cultural background and depth of personal research through which the writer has approached a field of work that is to him of absorbing interest, make the sequence of ideas here portrayed a very fascinatting survey. One is surprised also to find how closely the progress of this enquiry is interwoven with the history of philosophy itself, for nearly all the great thinkers of the past, as well as the leaders of medicine, have contributed their quota to the understanding of it, or, unfortunately, have in some cases ministered by their misinterpretations to a retardation of ideas that has held back the advance of civilization itself, sometimes for many centuries. As witness, the belief, long since proved erroneous, in the passive part taken by the female element in conception; the theory of pre-formation or pre-existence of parts in the embryo; and the so-called "theological embryology" which trammelled scientific thought in many quarters until the end of the 18th century. Indeed, one of the most important features of this work is the extreme clarity with which its author emphasizes the nature and the value of the various contributions made, so that the very errors that have not infrequently obscured the conclusions of even the greatest writers are held up for the encouragement as well as for the warning of those workers of today who are striving to follow in their footsteps in a spirit of true scientific humility.

Emphasis is further laid on the fact that practically all the authorities quoted have been consulted in the original, and the few sources not available to the writer are here conspicuously listed. Whenever possible, also, observations referred to are cited verbatim, a point that adds greatly to the interest of the text. Naturally, in this era, before the introduction of exact analytic methods or the invention of the compound microscope and discovery of the laws of optics, advances made were chiefly along morphological lines by direct objective study and dissection; but ever and anon, from the time of the first Hippocratic biologist on, a flash of insight caught the gleam of unknown forces at work in the developing embryo and many far-reaching truths were sensed by the mind of genius long before actual physical or biochemical proof was available.

The following brief citation of some of the main points in the four chapters into which the book is divided will serve to indicate the milestones along the line of progress and the kind and degree of exact knowledge that was attainable by the great thinkers of the periods into which its subject falls.

I. *Embryology in antiquity.* — The artificial incubation of hens' eggs, which has been carried out on a large scale by the Egyptians and Chinese from remote times, possibly as far back as 3000 B.C., is described and figured here, as practised in Egypt at the present day. The facilities for observation so afforded must have early drawn attention to the curious phenomena

* A History of Embryology. By Joseph Needham, Sc.D. Sir William Dunn Reader in Biochemistry in the University of Cambridge. XVIII — 274 pages, 40 illustrations. Price $4.50. Cambridge University Press. 1934.

revealed in the developing chick embryo, and this was the subject of endless speculation in the ancient as well as in the mediæval world. The first systematic investigation of the egg at successive stages of incubation is, however, that recorded by the biological writer in the Hippocratic books (*circa* 400 B.C.) of observations made under the natural method of hatching. After a remarkably suggestive discussion of the causation of development of the embryo on machine-like principles (*i.e.*, modern lines), in which he ascribes the main driving force of its growth to an internal "fire" (a thought corresponding surely to the oxidation of all living matter by chemical action), he ends his morphological description of the developing chick embryo with the following "proof". "Take 20 eggs or more and give them to 2 or 3 hens to incubate, then each day from the second onward till the time of hatching take out an egg, break it and examine it. You will find everything as I say in so far as a bird can resemble a man". "We see here", comments Dr. Needham, "as clearly as possible the beginnings of systematic embryological knowledge, and from this point onwards, through Aristotle, Leonardo, Harvey and von Baer to the current number of the *Archiv f. Entwicklungsmechanik, the line runs as straight as Watling Street*".

The next important step came in the herculean achievements of Aristotle (late 4th century) whose book "On the Generation of Animals" is described here as the first great compendium on this subject and of the same class and type as the modern textbooks of embryology by Balfour and Graham Kerr! As a result of his study of chick embryos at successive stages of incubation from the third day on, and the vast number of dissections made by him of embryos from every sort of animal available to him, he was able to construct a remarkable chart of comparative embryology (reproduced in the book) that laid the foundations of comparative morphology and supplied the framework also for the construction of the science of biology itself. His genius previsioned many modern ideas. Thus in a brilliant discussion of the problem of embryogenesis he recognized the antithesis between the theories of epigenesis or pre-formation (fresh development versus simple unfolding of pre-existent structures) and declared himself in favour of the former viewpoint; and he formulated in his writings views that foreshadowed the modern physico-chemical ideas of causation, such as the action of organic catalysts and the sort of clockwork mechanism that is apparently inherent in the ovum, and observed that in development general precede particular characteristics. A relatively large amount of space and much study has been devoted by our author to a careful estimation of the actual value of Aristotle's immense contribution to posterity, and the conclusion is drawn that the solid ground gained by his wonderful powers of observation and correct deduction far outweigh the effect of the few minor mistakes which naturally crept in to such a huge volume of work; although it is recognized that his insistence upon a biological explanation and Final Cause exerted an unfortunate influence on the progress of science in the hands of the scholastic metaphysicians of later generations, who were not possessed of his penetrating scientific genius and sense of relative values.

A little later than Aristotle the Alexandrian School was at its height (3rd century B.C.), and contributions were made under it to embryology by Herophilus and others, and later from Rome by Soranus (30 A.D.), whose accurate anatomical knowledge is shown in the picture by him of the uterus, the first made and which is figured; and by Galen (150-180 A.D.), whose valuable studies upon the morphology of the embryo were made subservient to his pronounced vitalistic convictions and thus as it were closed the door upon further experimentation for the next thousand years.

II. *Embryology from Galen to the Renaissance.*—The thousand years from the end of the second century A.D. are passed over here in a few pages, as yielding little of permanent importance to the subject. The "theological embryology" of the period is described as having reached its "lowest depths" in the treatises of the Abbess Hildegarde, of Bingen (1098-1190), whose description of the development of the fetus and entrance of the soul into this is embedded in an extraordinary medley of mystic and scientific speculations in which the old "cheese analogy" is brought into play. The Aristotelian tradition was however revived in the work of Albertus Magnus, of Cologne (1206-1290), with whom "the new spirit of investigation leapt into being, and the modern as opposed to the ancient period of embryology" is said to have begun. Noble tribute is paid to the extraordinary genius of Leonardo da Vinci (d. 1519), artist, philosopher, poet, statesman, who ranks also as one of the greatest biologists of all time, whose remarkable perceptive faculty led him, four hundred years in advance of his day, to make the first quantitative observation of embryonic growth, and who is described here as the father of embryology as an exact science, as Aristotle is of this as a branch of natural history. Then came that "encyclopædic group of biologists" of the 16th century, of whom Gesner was one, and among whom may be mentioned Aldrovandus (1522), who was the first after Aristotle to investigate hens' eggs at successive stages of incubation. His disciple Volcher Coiter, who in 1564 at Bologna "ordered 2 broody fowls to be brought and under each of them I caused 23 eggs to be placed, and in the company of these persons" (Aldrovandus and students) "I opened one every day so that we

could see firstly the origin of the veins and secondly what organ is first formed in the animal". . . "Coiter's importance," writes our author, "is that he assisted in the iconography of embryology, which was later to attain its climax in the plates of Fabricius". The latter (1604) was a good comparative anatomist, but drew many mistaken conclusions, which are in part compensated for by his beautiful and accurate drawings of the early chick embryo. The "De Humano Fœtu" of Arantius (1564) was an important book of this period which pointed out that the maternal and fetal vessels do not pass into each other by a free passage. Finally in this period must be mentioned the work of Jacob Rueff (1554) whose book "De Conceptu et Generatione Hominis" shows in a graphic illustration (figured) the Aristotelian idea of mixture of blood coagulum and seed in the uterus resolving after conception into a vascularized outline and finally into the solid form of the completed fetus (figured).

III. *Embryology in the 17th century.*—Here the modern period is now well under way, in the sense that the old conceptions that had dominated ideas were gradually being discarded in the light of a growing empiricism. Among the many names of significance in this field the following must be mentioned: Sir Kenelm Digby (1664), whose "clearly deterministic account of development" gives him a high place in biology, and who stands, in the words of this volume, "in the same relation to embryology as an exact science as does Bacon to science as a whole"; Nathaniel Highmore (1651), who first treated embryology from the anatomistic standpoint; Sir Thomas Browne, of revered memory, in whose "elaboratory" at Norwich the first experiments in chemical embryology were carried out; William Harvey himself, whose great work "De Generatione Animalium", the fruit of extensive investigations into the king's parturient does and hinds is second only in importance to his "De Motu Cordis", in that in it he expounded his pet doctrine of *omne vivum ex ovo* and declared against spontaneous generation, decided in favour of epigenesis (fresh development from inherent properties without pre-existing parts), destroyed for ever the mistaken theories of conception based on the teachings of Aristotle and figured by de Rueff (*vide supra*) and performed many services ably summarized here for the clearer understanding of this subject; Descartes (1662), in whose treatise on the formation of the fetus is said to have lurked, in spite of his mistakes, the vital spark that lay at the root of modern physico-chemical embryology; and Walter Needham (1667), described here as the founder of the dynamic aspect of embryology, as Sir Thomas Browne was of the static. So also de Graaf and Swammerdam, who discovered the follicles in the mammalian ovary in 1672, over a century before von Baer described the human ovum itself; Marcello Malpighi, whose beautiful reproductions of the early chick embryo as seen under the simple microscope pushed these observations back to the first hours of incubation; John Mayow, whose studies in fetal respiration were the first great contribution to physiological embryology; and Leeuwenhoek, who in 1677 discovered spermatozoa.

IV. *Embryology in the 18th century.*—This last chapter opens with an interesting classification of the various theories of nutrition, with name and date of the exponents of each. Among the great leaders of scientific thought who occupied themselves with embryogenesis in this period were: Herman Boerhaave, who gives in the second book of his "Elementa Chymiæ" the most detailed account of chemical embryology that had yet appeared, treated from the thoroughly modern standpoint and describing in great detail the biochemistry of the incubated egg; Albrecht von Haller, Boerhaave's greatest pupil, who published in 1767 a volume of his own collected papers on embryology, most of which were concerned with the development of the heart of the chick, and whose most original and fundamental work in this field was on the estimation of the rate of growth of the fetal bones (figured); Caspar Friedrich Wolff, whose extensive experimental work especially on the development of the intestine ruined the preformation theory and established that of epigenesis; and William and John Hunter, authorities upon the circulation of the placenta and other points.

A word regarding the many illustrations with which the book is enriched. These have been carefully chosen and so are of great assistance in the elucidation of the text. Most delightful is the page from Leonardo's note book showing his exquisite portrayal of the fetus *in utero* surrounded with small pencil sketches suggestive of his mechanistic explanation of the course of events in pregnancy and parturition; Malpighi's beautiful drawings of the chick embryo, at 85 hours' incubation, with the heart at this stage, the sinus venosus and aortic arches figured in separate detail; and the frontispiece of Harvey's "De Generatione Animalium" with Zeus liberating living beings from an egg which bears the inscription *Ex ovo omnia.* Others of equal interest are: a page from Nathaniel Highmore's "History of Generation" (1651) showing the development of the bean and indicating the analogy between this and the growth of the chick embryo; the facsimile of a page from von Haller's "Elementa Physiologia" (1766) presenting his observations on the growth in length and increase in weight from day to day of the embryonic long bones of the chick; Réaumur's illustrations of his famous incubators, specially invented by him for the artificial hatching of eggs; Buffon and his friends studying mammalian generation; and last, but not least, the

exquisite picture of Dr. Thomas Browne and his wife Dorothy, along with eight other portraits.

Enough has been said to indicate the very exceptional character of this fascinating and inspiring book, which will be perused with avidity alike by the research worker and the student of history and also, we believe, by the general reader. Its great interest springs not alone from the bearing which its content has upon the history of human thought, but also from the author's intimate familiarity with every part of his many sided subject, so that he has been able of his own depth of knowledge to eliminate inconsequent details and to bring to his treatment of it a vivid freshness of thought that makes his story of the past a vital part of the living present and through this of the unknown future—*And this is history.*

Association Notes

The Meeting at Atlantic City

SECTION ON OPHTHALMOLOGY

This Section convened on June 12th under the joint chairmanship of Dr. W. Gordon M. Byers, Montreal, for Canada, and of Dr. Arthur J. Bedell, Albany, N.Y., for the United States.

Dr. Byers extended greetings from Canada.

Dr. Bedell spoke on "Stereoscopic Fundus Photography".

The following papers were read.

Papillœdema and Optic Neuritis: A Retrospect.—MR. LESLIE PATON, London, England.

Inflammatory Exophthalmos in Catarrhal Disorders of the Accessory Sinuses.—DR. M. COHEN, New York.

Inflammatory exophthalmos is a term applied to cases of exophthalmos combined with ocular inflammation in contradistinction to non-inflammatory exophthalmos, as seen in exophthalmic goitre. It is caused by an inflammatory reaction in the retrobulbar tissues. The main cause of this reaction is sinus disease. In the acute or subacute types, without abscess formation, surgical procedures should be avoided owing to the possibility of spreading infection to the cranial cavity and the cavernous sinus. In the prolonged chronic cases the Krönlein operation was performed in order to decompress the orbital contents. A Naffziger operation was also performed in a chronic case, resulting in relief of the condition. Four cases were considered, two of the subacute and two of the chronic type.

Association of Ectopia Lentis with Arachnodactyly.—DR. F. E. BURCH, St. Paul.

The incidence of ectopia lentis with Marfan's syndrome, "arachnodactyly", is proved in 50 per cent of cases. This syndrome is hereditary and familial, characterized by marked growth anomalies with skeletal changes predominant (dolichocephalic skulls, wedged-shaped mandibles and high-arched palates, spinal curvature and flat long chest, with abnormal sternums) and frequent cardiac involvement. The extremities are markedly elongated. Absence of fatty tissue and amyotonia are usual. The disease sometimes resembles gigantism without acromegalic features. That arachnodactyly is accompanied by congenital bilateral subluxation of the crystalline lens is often overlooked. The arachnodactylic phenomena are growth anomalies of mesodermal origin. The associated dehiscence in the suspensory ligament is explained by mesodermic changes in the embryonic vascular tunic of the crystalline lens. The factors that produce these mesoblastic growth changes may be of endocrine origin. The hereditary character may be explained on the chromosomatic basis.

The Treatment of Anisophoria.—DR. J. S. FRIEDENWALD, Baltimore.

Anisophoria, that condition in which the degree of heterophoria varies with the direction of gaze, may be produced by paresis or spasm of the extra-ocular muscles or by the wearing of glasses of markedly unequal power. Partial correction may be achieved by inserting prism segments into the lenses, as in bifocals, by centring the reading glasses differently from the distance glasses, or by tilting the head in reading. Method of more complete correction. If there is no anisophoria, aniseikonia of considerable degree can be tolerated without symptoms, whereas anisophoria without aniseikonia causes severe symptoms. Methods for testing anisophoria with the usual equipment were explained. Lenses on a base curve of —20 dioptres or less and with a thickness of 10 mm. or less will correct as much as 6 degrees of anisophoric variation from the axis to the periphery. For higher degrees of correction two-lens systems are required.

The Causes of Blindness in Children: Their Relation to Preventive Ophthalmology.—DR. C. BERENS, New York.

Data were presented on causes of blindness among 2,702 children in schools for the blind. Outstanding etiological groupings, in order of importance, are (1) congenital and hereditary conditions (51 per cent); (2) infectious diseases (29 per cent), including ophthalmia neonatorum (11 per cent) and syphilis (5 per cent); (3) traumatic and chemical injuries (8 per cent). The study revealed that (1) there is a need for more intensive study of causes, particularly the determination of etiological factors; (2) the schools need more ophthalmological service, which should include corrective operations and treatments as well as examination service; (3) a qualified nurse or medical social worker is needed to assist the ophthalmologist and to do follow-up preventive work with the families of pupils; (4) ophthalmologists should urge that known preventive measures, such as prophylaxis, and medical care for ophthalmia neonatorum, routine Wassermann tests, and adequate treatment for syphilitic patients, be more widely used.

The Pupillary Reactions in Combined Lesions of the Posterior Commissure and of the Pupillodilator Tracts.—DRS. N. P. SCALA, Washington, D.C., and E. A. SPIEGEL, Philadelphia.

The pathogenesis of the Argyll-Robertson pupil was discussed, based on experimental lesions of the midbrain. It was shown that lesions of the posterior commissure diminish but do not abolish the pupillary light reflex. If such injuries are combined with severance of the pupillodilator tracts in the midbrain, slight miosis and a slight impairment of the pupillary reaction to painful or emotional stimuli are observed, but no true Argyll-Robertson pupil results. This phenomenon can-